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First Report of Deviation in Sturdiness Quotient (SQ)

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of Khejri (Prosopis cineraria) Seedlings Sangeeta Singh1*, Tanmaya Kumar Bhoi1, Vipula Vyas1, Kuldeep Sharma1, Indar Singh1 and Bindu Nirwan1, 1Forest Protection Division, Arid Forest Research Institute, Jodhpur, Rajasthan, 342005 *Correspondence: E -mail: singhsangi123@gmail.com

Abstract Sturdiness Quotient (SQ) is the growth standard to determine the good quality of seedlings at nursery conditions. Here, we studied the SQ of Khejri seedlings at nursery conditions, but the SQ value was found to be contradictory with normal which is always less than six. In our experiment in two different years, the SQ value more than six for the Khejri tree and it was not always less than six which is universal. As per our knowledge and based on experimentation data we conclude that the SQ value of the khejri tree is lies between 13 ± 7. Key words: Sturdiness Quotient (SQ), Khejri seedlings

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Introduction Prosopis cineraria, also known as Khejri, is a major indigenous tree species found in India's northwestern plains, where it grows in dry tropical forests and tropical thorny forests (Parkash and Hocking, 1985). It is an important tree in the forestry system and has a significant economic impact in the Indian desert.

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Because of its multiple economic values and suitability in agroforestry systems, it is conserved in arable land where its population is managed by the farmer (Saxena, 1979).

This is mostly a plains tree with gently undulating ground and ravine terrain, rarely extending into hills, and only growing at elevations of 50–800 metres (Anonymous, 1980). In plantation and agroforestry systems in arid and semi-arid regions,

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trees with a monolayered canopy (Bisht and Toky, 1993) and a deep root system are recognised as one of the essential tree species suitable for fuel wood, timber, and forage (National Academy of Sciences, 1983). When this plant is exposed to field conditions, however, it faces numerous difficulties. One of them is the development of low-quality seedlings in

the nursery stage. Seedling mortality after release to field conditions is a major constraint in Khejri. A seedling's genetic characteristics can be used to determine its consistency. Because of an inability to consider seedling quality as a factor in plant success in the field, many tree plantings have failed. The traditional method of judging seedling quality solely on the basis of plant height is impractical (Grossnickle, 1992). The establishment of a plantation relies heavily on the planting of high-quality tree seedlings. Young seedlings'

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growth and survival are influenced by vigour, growth rate, and resistance to environmental stress. Several morphological measurements have been developed and used to predict tree seedling field performance as well as their ability to withstand mechanical and environmental stresses (

Takoutsing et al., 2013). Both of these methods, however, are harmful and could result in the death of one or more seedlings. A non-destructive alternative to measuring seedling quality is the sturdiness quotient index which compares seedling height (cm) to

measures a seedling's vigour and robustness.

To be considered solid, a seedling must have a value of less than six. A low quotient indicates a tough plant that will thrive in windy or dry conditions. Materials and methods The seeds of Khejri were treated with a formulation of the Arboscular Mycorrhiza (AM) fungi Piriformospora indica, Azotobacter spp, and consortia of both these microbes as part of a routine study to see how they affected the growth and development of Khejri seedlings at the nursery stage. The experiment was carried out at the Arid Forest Research Institute's Nursery in Jodhpur, Rajasthan. The seeds were planted in polybags (13 × 26 cm) filled with potting soil (Farm yard manure: Garden soil: Sand, 1.5: 1: 1). After six month at seedling stage growth parameters like collar diameter, shoot length, root length, biomass, sturdiness quotient, quality index, vigour index were calculated. In this experiment we were mainly focused on sturdiness quotient (SQ) of Khejri plant which was an important parameter for determining the survival rate of Khejri seedlings in field condition after released from nursery. Side by side control was also taken in order to compare the results of SQ with PGP treatment. There were total three treatment (T1= P. indica, T2= P. indica + Azotobacter spp, T3= Azotobacter spp) and one control (Without PGPR). For each treatment three replication and five plants per replication were taken and data was recorded in two consecutive year 2015-16 and 2016-2017. Another

collar diameter, shoot length and SQ. Statical analysis The data on various Khejri seedling growth parameters were subjected to analysis of variance (ANOVA) using a complete randomised design. Using the statistical software SAS® version 9.2, the significance of differences between treatments was tested using the F-test, and the treatment means were compared using least significant differences (LSD) at P = 0.05. Results In both the year result of SQ for khejri tree was found to be contradictory and it was more than six. The studies on growth parameters of different Khejri seedlings found that collar diameter, shoot length and sturdiness quotient (SQ) were varied

Table 1) in the year 2015-16 and for the year 2016-17 the studies also showed the significant differences in collar

Table 1). The SQ for the control in Khejri seedlings was found to be higher 20.62 as compared to other treatments. However, for T3 treated seeds it was significantly lower as compared to other treatments and control but not less than six. The collar diameter of khejri seedlings for control was found to be 0.90 mm and shoot length was 18.56 cm which was very low in order to get accurate ratio of SQ. Furthermore, in case of both T1 alone and mixed consortium of T2 the SQ value of Khejri seedlings were significantly decreasing because of higher collar diameter growth as compared to control. The similar trend was also followed in the year 2016-17, the SQ for the control was significantly higher as compared to other three treatments. In another experiment collar diameter, shoot length and sturdiness quotient (SQ) were varied between 2.13

to 4.00 mm, 32.93 to 29.56 cm and 8.44 to 13.16 in the year 2019-2020 respectively. These studies further revealed that significant differences in collar diameter (F=35.83; df=3,11; P>0.001), shoot length (F=16.16; df=3,11; P>0.001) and sturdiness quotient (F=144.17; df=3,11; P>0.001) (

Table 2) in the year 2019-2020. The SQ for the control in Khejri seedlings was found to be higher 13.16 as compared to other treatments. However, for T4 treated seeds it was significantly lower as compared to other treatments and control but not less than six. Furthermore, in case of both T3 and T4 the SQ value of Khejri seedlings were significantly decreasing because of higher collar diameter growth as compared to control.

Table 1: SQ of Khejri tree seedlings 2015-17 Treatments Collar diameter (mm) Shoot Length (cm) Sturdiness Quotient (SQ)

2015-16 2016-17 2015-16 2016-17 2015-16 2016-17 T1 1.97 1.77 22.82 20.56 11.60 11.60 T2 2.00 2.06 28.66 26.58 14.71 12.78 T3 1.88 1.89 20.50 19.82 10.05 10.09 Control 0.90 1.01 18.56 17.34 20.84 17.00 LSD (P=0.05) 0.37 0.21 5.07 2.59 3.62 0.921 P- value >0.001 >0.001 >0.012 >0.001 >0.001 >0.001

Table 2: SQ of Khejri tree seedlings 2019-2020 Treatments Collar diameter (mm) Shoot Length (cm) Sturdiness Quotient (SQ) T1 3.06 32.86 10.82 T2 3.03 31.13 10.32 T3 3.40 32.16 9.26 T4 4.00 32.93 8.44 T5 2.70 30.83 11.40 T6 2.50 30.16 12.39 Control 2.13 29.56 13.16 LSD (P=0.05) 0.310 0.991 0.449 P Value >0.001 >0.001 >0.001

Discussion According to current research, the SQ value of Khejri seedlings was greater than six. To the best of our knowledge, the normal SQ value of Khejri seedlings is somewhere between 13 and 7. However, it is less than six for other tree species and is a good indicator of high-quality seedlings. These results match those of Black spruce seedlings with a SQ greater than six (Roller, 1997). This unusual occurrence could be due to the arid and dry conditions in Rajasthan, which limit seedling growth and cause high SQ, resulting in higher mortality when released to the field.

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of Khejri (Prosopis cineraria) Seedlings Sangeeta Singh1*, Tanmaya Kumar Bhoi1, Vipula Vyas1, Kuldeep Sharma1, Indar Singh1 and Bindu Nirwan1, 1Forest Protection Division, Arid Forest Research Institute, Jodhpur, Rajasthan, 342005 *Correspondence: E -mail: singhsangi123@gmail.com

of Khejri (Prosopis cineraria L) Seedlings at Nursery Stage Sangeeta Singh1*, Tanmaya Kumar Bhoi1, Vipula Vyas1, Indar Singh1and Kuldeep Sharma1 1Forest Protection Division, Arid Forest Research Institute, Jodhpur, Rajasthan, 342005 *Correspondence: E -mail: singhsangi123@gmail.com

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Introduction Prosopis cineraria, also known as Khejri, is a major indigenous tree species found in India's northwestern plains, where it grows in dry tropical forests and tropical thorny forests (Parkash and Hocking, 1985). It is an important tree in the forestry system and has a significant economic impact in the Indian desert.

Introduction Prosopis cineraria, often known as Khejri, is a major indigenous tree species of India's north-western plains, a component of dry tropical forests and tropical thorny forests (Parkash and Hocking, 1985). It is an important tree in the farming system and plays a key part in the Indian desert

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Because of its multiple economic values and suitability in agroforestry systems, it is conserved in arable land where its population is managed by the farmer (Saxena, 1979).

Because of its multiple economic value and suitability in agroforestry systems, it is conserved in arable land where its population is regulated by the farmer (Saxena,1977).

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3/10	SUBMITTED TEXT	59 WORDS	58%	MATCHING TEXT	59 WORDS

trees with a monolayered canopy (Bisht and Toky, 1993) and a deep root system are recognised as one of the essential tree species suitable for fuel wood, timber, and forage (National Academy of Sciences, 1983). When this plant is exposed to field conditions, however, it faces numerous difficulties. One of them is the development of low-quality seedlings in

Trees with a monolayered canopy (Bisht and Toky, 1993) and a deep root system are acknowledged as one of the major tree species (Arya et al., 1992) suitable for fuel-wood, timber, and pasture in plantation and agroforestry systems in dry and semi-arid regions (National Academy of Sciences, 1983).However, when this plant is exposed to field settings, it faces numerous obstacles. One of them is the nursery-stage production of low-quality seedlings. In

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5/10	SUBMITTED TEXT	40 WORDS	46%	MATCHING TEXT	40 WORDS

growth and survival are influenced by vigour, growth rate, and resistance to environmental stress. Several morphological measurements have been developed and used to predict tree seedling field performance as well as their ability to withstand mechanical and environmental stresses (

Growth and survival of young seedlings are functions of vigor, growth rate and resistance to environmental stress. Various measurements of morphological characteristics have been developed and used as a tool to predict field performance of tree seedlings and their ability to tolerate mechanical and environmental stresses [2].

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10/10	SUBMITTED TEXT	22 WORDS	65%	MATCHING TEXT	22 WORDS

root collar diameter (mm). The sturdiness quotient (SQ), which is the ratio of the seedling's height to the root collar diameter,

root collar diameter (mm). The sturdiness quotient (SQ) refers to the ratio of the height of the seedling to the root collar diameter

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6/10	SUBMITTED TEXT	173 WORDS	98%	MATCHING TEXT	173 WORDS

experiment was conducted in 2019- 2020 at the Nursery of Arid Forest Research Institute, Jodhpur. Seeds were germinated in steam sterilized sand medium. Healthy and uniform size (about 5 cm height) seedlings were transferred to 13×26 cm size polythene bag with a potting mixture of sand: red soil: farm yard manure (1:1:1.5). The seedlings of Khejri were treated with consortium of Rhizobia, Azotobactor and Bacillus to study their individual as well as combined effect on the growth and development of Khejri seedlings in seven different treatments including control (T1-Rhizobia, T2-Rhizobia + Azotobactor, T3-Rhizobia+ Bacillus, T4-Rhizobia+ Azotobactor +Bacillus, T5-Azotobactor and T6-Bacillus; one control) with each having three different replications. Ten days after transplanting, 30ml inoculum suspension of respective treatment at a concentration of 5:22×107 CFU ml–1 was applied to each bag at 5cm depth near the root zone by making holes with the help of stick. Seedlings were watered to maintain soil moisture and no nutrients were added. Seedlings were kept in nursery condition for 6 months and data was recorded on

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7/10	SUBMITTED TEXT	59 WORDS	42%	MATCHING TEXT	59 WORDS

between 0.90 to 2.00 mm, 18.56 to 28.66 cm and 10.05 to 20.84 and 1.01 to 2.06 mm, 17.34 to 26.66 cm, and 10.9 to 17.0 in both the year 2015-16 and 2016-17 respectively. These studies further revealed that significant differences in collar diameter (F=21.74; df=3,11; P>0.001), shoot length (F=7.14; df=3,11; P>0.001) and sturdiness quotient (F=16.37; df=3,11; P>0.001) (

between 2.00 to 2.90 cm, 31.17 to 46.67 cm, 35.80 to 57.67 cm, 129.00 to 365.00, 1.07 to 2.70 g, 0.90 to 3.17 g, 0.57 to 1.73 g and 0.53 to 1.67 g respectively (Table : 2). These studies further revealed significant differences incollar diameter (F=8.72; df=6,12; P>0.001), shoot length (F=678.29; df=6,12; P>0.001), root length (F=1287.14; df=6,12; P>0.001),

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8/10	SUBMITTED TEXT	16 WORDS	70%	MATCHING TEXT	16 WORDS

diameter (F=49.23; df=3,11; P>0.001), shoot length (F=24.33; df=3,11; P>0.001) and sturdiness quotient (F=67.06; df=3,11; P>0.001) (

diameter (F=8.72; df=6,12; P>0.001), shoot length (F=678.29; df=6,12; P>0.001), root length (F=1287.14; df=6,12; P>0.001),

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9/10	SUBMITTED TEXT	41 WORDS	50%	MATCHING TEXT	41 WORDS

to 4.00 mm, 32.93 to 29.56 cm and 8.44 to 13.16 in the year 2019-2020 respectively. These studies further revealed that significant differences in collar diameter (F=35.83; df=3,11; P>0.001), shoot length (F=16.16; df=3,11; P>0.001) and sturdiness quotient (F=144.17; df=3,11; P>0.001) (

to 3.17 g, 0.57 to 1.73 g and 0.53 to 1.67 g respectively (Table : 2). These studies further revealed significant differences incollar diameter (F=8.72; df=6,12; P>0.001), shoot length (F=678.29; df=6,12; P>0.001), root length (F=1287.14; df=6,12; P>0.001),

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